Landsat 7 Processing System (LPS) Project Management Plan

Revision 1

May 1995

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Prepared by:

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Joy Henegar/563 Date
LPS Project Manager

Approved by:

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Dorothy Perkins Date
Chief, Information Processing Division

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J. B. Martin/502 Date
L7 Ground Systems Manager

Section 1 Introduction

1.1 Purpose and Scope

The purpose of this document is to outline the strategy for the management of the Landsat 7 Processing System (LPS) requirements analysis, design, development, integration, test, and maintenance.

1.2 Document Organization

This document is organized into 9 sections. Section 1 provides the introduction and project overview. Section 2 provides a description of the high level requirements to be met by the LPS. Section 3 describes the plan for system development including procurement strategy and software development methodology. Section 4 discusses facilities. Section 5 describes the Work Breakdown Structure for the LPS and provides a discussion of the resources required. Section 6 discusses the GSFC LPS Project Organization and the roles and responsibilities assigned to each lead. Section 7 describes the external coordination. Section 8 describes the risk management approach and Section 9 shows the LPS development schedule and high level Release Implementation Plan.

1.3 Document Maintenance

This document will be maintained by the LPS Project Manager and updated as necessary to insure the successful development of the LPS.

1.4 Project Overview

The Landsat 7 Processing System (LPS) is being developed by the Goddard Space Flight Center (GSFC) Mission Operations and Data Systems Directorate (MO&DSD) Information Processing Division (IPD). The system will be delivered to the Earth Resources Observation System (EROS) Data Center (EDC) in Sioux Falls, South Dakota.

The system will provide data capture, rate buffering, Level 0, and Level 0 R processing of wideband data from the Enhanced Thematic Mapper (ETM+) instrument onboard the Landsat 7 spacecraft. The system will receive data from the Landsat Ground Station (LGS)at EDC. The system will transfer processed data sets to the Land Processes Distributed Active Archive Center (LP DAAC) also located at EDC. The system will provide data sets consisting of a meta-data, browse image and spectral band deinterleaved scanlines from a single ground station acquisition. Data sets will be available within 16 hours after receipt.

The Concept and Mission Definition Phase for LPS began in the Fall of 1993 in the face of the Air Force decision to leave the then ongoing Landsat 7 program. The NASA restructuring and descoping culminated in the NASA Administrator's program certification in May 1994.

Section 2 LPS Requirements Overview

The following outlines the high level requirements to be met by the LPS.

- The LPS shall receive raw wideband data from the Landsat 7 Ground Station (LGS).
- The LPS shall receive 4 physical channels of serial data at 75 Mbps per channel.
- The LPS shall record all raw return link data.
- The LPS shall have the capability of supporting a return link session duration of up to 14 minutes.
- The LPS shall retain captured wideband data for a minimum of 60 days.
- The LPS shall process all wideband data to Level 0R within 16 hours after receipt from the Landsat 7 spacecraft.
- The LPS shall be capable of receiving wideband data in CCSDS Advanced Orbiting System (AOS) format.
- The LPS shall provide mission operations for a minimum of 5 years.
- The LPS shall be capable of receiving the equivalent of 250 scenes per day.
- The LPS shall have the capability to handle 12 Mbps daily average aggregate data rate.
- The LPS shall generate the following standard products: Level 0R, metadata and browse files.
- The LPS shall process all wideband data received to Level 0R on a return link session basis.
- The LPS shall provide the capability to reprocess wideband data.
- The LPS shall provide CCSDS AOS Grade-3 service on the wideband data.
- The LPS shall have the capability to perform Bose-Chaudhuri-Hocquenghem (BCH) error detection and correction decoding.
- The LPS shall provide return link quality and accounting information for all wideband data as part of the metadata product.
- The LPS shall process all wideband data received per return link session by VCID within each physical channel.
- The LPS shall perform Automatic Cloud Cover Assessment (ACCA).
- The LPS shall be staffed to support integration and test prior to launch.
- The LPS shall notify the LP DAAC regarding the availability of Level 0R, metadata, and browse files.
- The LPS shall allow the LP DAAC to electronically retrieve data files.
- The LPS shall receive confirmation for the successful retrieval of data files from the LP DAAC.
- The LPS shall have an operational availability for data processing functions of 0.96 or better and a MTTR of 4 hours.
- The LPS shall introduce no more than one bit error in 10**9 bits processed.
- The LPS shall protect all data within the LPS as Sensitivity Level TBD as specified in Applicable Document 3, NASA Automated Information Security Handbook except for sect 403d(2), Information and Applications Labels.

Section 3 System Development

The LPS is a Level II project. The Project Approval Review will be chaired by the IPD Chief. The PAR will include the system concept, the PMP, and the level 2 requirements. Budget will be presented in closed session.

3.1 Development Approach

The LPS is being implemented using modular, distributed architecture utilizing state-of-the-art, high performance computer server technology. The system is arranged in processing strings consisting of a high rate recorder to capture data and a medium rate processing system to process the rate buffered data. The system accepts 4 physical data streams into four independent strings. The system is modular since additional strings may be added to improve operational availability. A fifth string is planned for system maintenance, training and backup.

The traditional front end functions of frame synchronization, and error decoding may be performed by either custom telemetry processing components, commercially available computer cards, software, or a combination of each. System engineering trade studies as well as prototyping will determine the best solution. All other elements of the system are commercial off-the-shelf (COTS) workstations, X terminals, and networking equipment. The implementation will consist of the development of software processing algorithms and the procurement as well as integration of the hardware components.

Prototyping was initiated in March 1994 to assess performance of critical processing areas. The protoytping phase will run in parallel with the development up until CDR. Prototyping will be carefully approved to assure clear goals prior to start.

The LPS development will be a joint SEAS and GSFC effort. NMOS will not be involved in either operations or acceptance test.

The Acceptance Testing and Operations will be planned and executed by the EDC.

3.2 Development Methodology

The LPS project will follow the standard waterfall method for development with input from the SEAS System Development Methodology (SSDM). However, this methodology will be customized to meet the needs of the project. The project will consist of the following Project Life Cycle Phases:

Project Definition and Conceptual Phase
System Requirements Analysis/Operations Concept Definition
System Design
Software Requirements Analysis
Preliminary Design
Detailed Design
Implementation

Details on each of these phases are documented in section 4 of the LPS Software Management Plan which is contained in Appendix A. The Software Management Plan details the activities to be conducted in each phase, the documentation to be generated, and standards to be followed.

In order to streamline the development process, the LPS will be combining several of the traditional reviews. The LPS will provide a System Requirements Review, a System Design/Software Specification

Review, and a Detailed Design Review consistent with the schedule outlined in Section 9.

The system will be developed and integrated in a series of software builds and releases. High level functionality to be provided in each build and release is described in section 9.

3.3 Procurement Plan

The operational hardware procurement profile will be shifted later in the project due to current budgetary projections. An adequate development environment will be established early in the project to allow efficient development and testing. Funds for prototype equipment are allocated early in the project in order to critic various hardware architecture. This will be supplemented with a development server to house the CASE tools needed for development.

It is anticipated that two complete strings of the chosen architecture will be sufficient early on to support development and testing. The final strings will be integrated and tested at GSFC prior to shipment to EDC.

As an update, a prototype Challenge XL machine, was purchased during the hardware trades. Challenge XLs were chosen for the final string architecture as well. The prototype machine could potentially be upgraded at a TBD cost to be compatible with the 5 operational strings. This will provide a complete sixth string for the LPS and can be provided to EDC at an agreed upon time after transition of system maintenance to EDC. This prototype machine will be used during the maintenance of the system at GSFC after delivery to EDC in order to minimize the maintenance costs and problems associated with maintenance at a remote site.

3.4 Data Management

The project plans to use as much electronic document production as possible and to minimize the use of paper. The manpower required for this area will be kept at an absolute minimum. A Macintosh Server has been established on the Goddard Backbone for this service. Standards and Procedures for documentation configuration management, server access, and application software will be generated early in the project and modified as necessary.

3.5 Configuration Management Policy

The IPD Configuration Management Plan will be used. The IPD Automated Change Control Request(CCR) System (ICAS) will be utilized, thus minimizing the manpower necessary for maintaining configuration management.

A Project Configuration Management Board (PCMB) will be established by the LPS Project Manager and consist of the Project Manager as Chairman, and the System Engineer, Software Manager, and Hardware Manager as members. The PCMB is responsible for tracking changes to the element level requirements, design and implementation baselines.

The Code 560 CCB will be responsible for approving changes which effect cost, schedule, and/or requirements at the Ground System Element level. The Code 560 CCB will be the approval organization at all LPS Reviews.

The LPS Project Manager will also be a member of the Ground System CCB which will be established by the Ground System Manager, Code 502. This

CCB will be responsible for approving changes effecting cost, schedule, and requirements at the ground system level.

3.6 Quality Assurance Policy

Quality is an important aspect of the design. The project intends to empower each member of the team to take action to improve quality. It is not within the scope of this budget to separately assign a single person to plan, monitor, control or assure quality. The team has a mutually dependent stake in the quality of the product. The team is tasked to assure the quality of the product. However, the SEAS contractor, as is their policy, will provide a part time quality assurance person to conduct audits.

3.7 Automated Information System (AIS) Security Policy

NASA has the responsibility to design security features into the LPS for use by the end user.

The EDC is responsible for implementation of security policy and procedures at their facility.

3.8 Project Development History

The design documentation generated throughout the early phases, followed by the design changes in CCRs, as well as monthly status charts, are accurate chronicles of planned verses actual and form the basis for a project history. An informal effort to note lessons learned will be accomplished after each life cycle. Members of the team will meet to discuss lessons learned from the previous phase and develop plans for improvements in the upcoming phase. Minutes from these meetings will be generated and serve as the lessons learned documentation. No other formal project development history will be kept by the LPS project.

Section 4 Facilities

Space has been established in GSFC Building 23 Room W322D for the LPS development environment. This space will be made available by the end of March 1995. For the small amount of equipment received before this data, space will be provided in the Code 564 development laboratory on the third floor of building 23.

The LPS will be installed at the EDC in Sioux Falls, SD. The EDC will be responsible for the generation of the LPS Facility Plan.

Section 5 Work Breakdown Structure

Using the following Work Breakdown Structure (WBS), the following statements of work and estimates of personnel are outlined. The development will be a joint GSFC and SEAS effort.

Project Management
System Engineering
Hardware & Firmware
Software
System Integration & Test
ILS
Transition & Training
O&M

5.1 Project Management

Project Management will consist of one full time civil servant and no more than one contractor. Contractor personnel acting as task leads subordinate to the project manager, are expected to have hands on involvement.

5.2 System Engineering

System Engineering will consist of two to four full time equivalent civil servants and four contractors. System Engineering personnel are expected to continue on in the role of integration and test personnel. Their familiarity with the system requirements, design, and technology used makes them ideally suited for the task. This also avoids the penalty of involving I&T personnel early in the project simply for them to gain familiarity without having any crucial deliverables.

5.3 Hardware and Firmware

Hardware and Firmware will consist of one civil servant who will work closely with system engineering and software development. The hardware manager will be responsible for the management of firmware. Firmware is developed under standards set by the software manager. Although the differences have been blurred with recent technology advances, processes tightly coupled with hardware will be considered firmware. This work breakdown also includes the procurement of commercial hardware and development, if necessary, of custom hardware.

5.4 Software

Software will consist of a software manager, software engineer, and possibly an in house software manager civil servant. The software manager will determine the necessity of establishing an in-house software manager. Contractor support will consist of a task leader and personnel to provide approximately 65,000 lines of code.

5.5 System Integration and Test

System Integration and Test will be performed by system engineering personnel. This ensures detailed knowledge of the system by personnel who are retained throughout the project. This team will complete subsystem integration and system testing.

5.6 Integrated Logistics Support

For ILS during the development phase, NASA will carry vendor maintenance on commercial equipment. Any custom equipment will be maintained by the developer. The EDC will be responsible for ILS after delivery. The EDC is responsible for planning and implementation of ILS policy. System Engineering will weigh this factor during design. The design will maximize the use of commercial equipment to ease the ILS requirements.

5.7 Transition and Training

Transition and training of the completed system to the EDC will be jointly planned by the LPS project and EDC and approved by the Landsat 7 Project. A factory acceptance test, planned by the EDC will be run at GSFC prior to approval for shipment. NASA will plan the LPS transition and the LPS installation. NASA will provide: Operations and Maintenance Manuals, a Users Guide, and provide familiarization training for EDC personnel. It should be noted that development personnel will be moving on to new projects after the final delivery. Therefore scheduling of this training will be as soon as possible after installation. EDC will be responsible for their operator training and certification.

To insure a successful transition of LPS to the operational environment the EDC personnel will be included in design and review processes. Their views, based on the ongoing operations at EDC, are valuable inputs.

A Factory Acceptance Test will be planned, performed and certified by EDC at GSFC prior shipment. This will allow any defects or deficiencies to be analyzed and fixed in proximity to the development team. Subsequent to delivery, software maintenance will be conducted via the internet until EDC completes transition.

5.8 Operations and Maintenance

NASA will provide Operations and Maintenance Manuals, as well as all development documentation. NASA will transition maintenance responsibility to EDC by a negotiated post-launch date. The EDC will provide planning and implementation of the O&M phase. NASA personnel will be available for consultation. A formal support agreement is the responsibility of the Landsat 7 Project.

5.9 Project Management Tools

No formal project wide earned value method will be implemented. Individual managers are allowed to use the technique within there area. Within the SEAS contract, there are requirements for using the PMS. The monthly status review as well as design reviews will provide subjective insight to progress. Weekly project status meetings will provide internal assessment.

Section 6 GSFC LPS Project Organization

The following outlines the LPS Project Organization and the Roles and Responsibilities of each. The Organization Chart is depicted in Figure 1.

6.1 LPS Project Manager

The responsibilities of the LPS Project Manager are as follows:

- Responsible for the implementation of LPS
- Responsible for controlling budgets, schedules, and performance of LPS
- Technical management of LPS Project
- Reports status to upper management
- Serves as point of contact to Landsat 7 Ground Data System Manager
- Identifies and obtains resources within Code 560
- Chairs LPS Project Configuration Management Board (PCMB)
- Prepares inputs to staff performance appraisals as required
- Prepares and maintains the LPS PMP

6.2 LPS System Engineering Manager (SEM)

The responsibilities of the LPS System Engineering Manager are as follows:

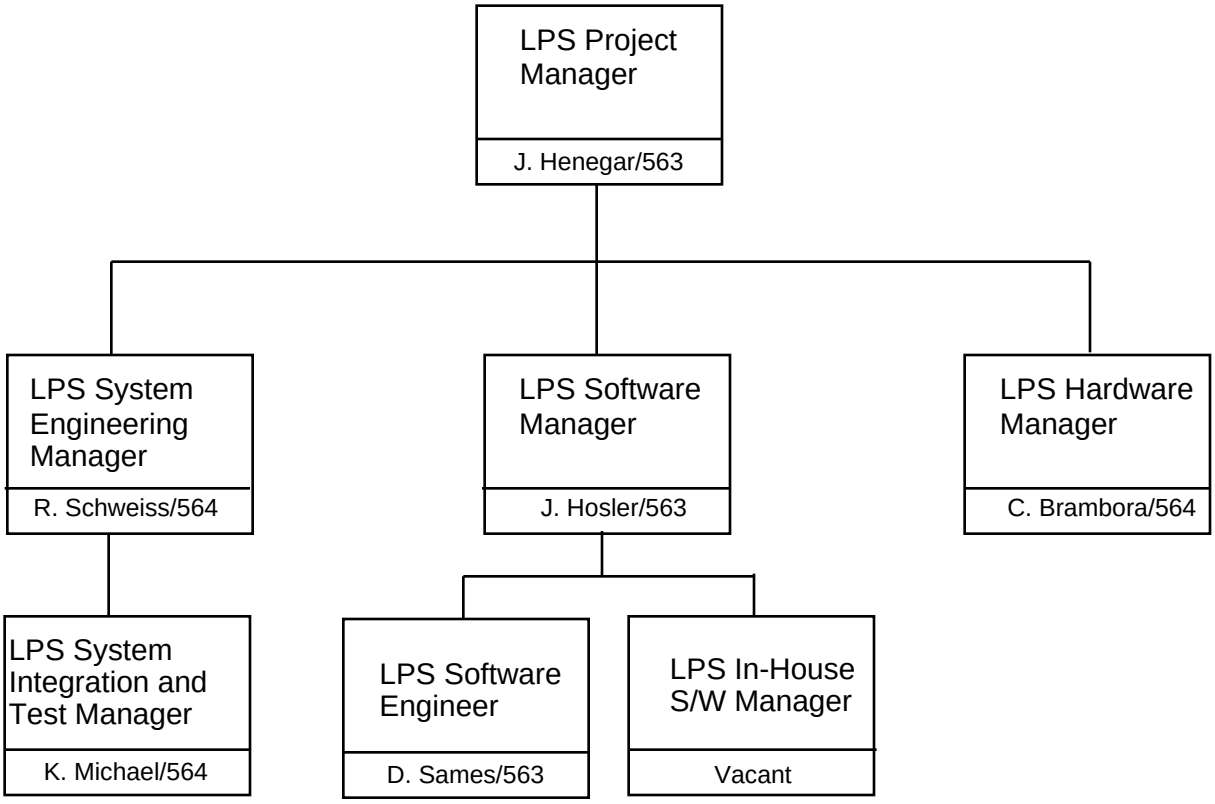
- Responsible to the Project Manager for LPS System Engineering activities and products
- Heads the LPS system engineering team
- Serves as Deputy LPS Project Manager as required
- Serves as ATR for the LPS SEAS System Engineering task
- Evaluates SEAS task support
- Maintains system engineering planning documentation
- Maintains LPS requirements baselines
- Establishes risk assessment and determines study and advanced technology priorities and assessments
- Manages special emphasis studies for risk mitigation
- Develops and maintains all IRD's, approves all ICD's, and Data Format documentation
- Functions as focal point for all system-level LPS design activities
- Member PCMB, serves as alternate PCMB Chair
- Approves, oversees, and monitors transition activities in coordination with personnel at EDC
- Other duties as assigned by the LPS PM
- Approves and maintains the Operations Concept
- Develop, approve and maintain the LPS Transition Plan and schedules in coordination with personnel at EDC

6.3 LPS Integration and Test Manager

The responsibilities of the LPS Integration and Test Manager are as follows:

- Responsible for all subsystem integration and system test activities and products
- Collects and maintains RMA data measurements
- Oversees and monitors LPS integration and testing activities
- Interfaces with Landsat 7 Project regarding Independent Verification and Validation test activities
- Approves, oversees, and monitors mission contractor system testing documents

Figure 1 LPS Organization Chart



6.4 LPS Hardware Manager (HM)

The responsibilities of the LPS Hardware Manager are as follows:

- Responsible for all LPS hardware activities and products
- Responsible for procurement of all system hardware
- Approves, oversees, and monitors hardware development and test activities
- Establishes hardware policies, standards, and plans
- Reviews and evaluates hardware-related products
- Defines applicable hardware-related prototyping efforts
- Member PCMB regarding hardware-related changes to controlled baselines
- Evaluates applicability of new hardware technologies to LPS
- Develops and maintains hardware interface requirements

6.5 LPS Software Manager (SM)

The responsibilities of the LPS Software Manager are as follows:

- Responsible for all LPS software activities and products
- Responsible for controlling budgets and schedules for all LPS software developments
- Responsible for the procurement of all software development tools in conjunction with SEM
- Serves as ATR for SEAS software development task
- Evaluates SEAS task support
- Responsible for technical management of LPS in-house software development efforts
- Manage software team activities
- Manage software integration and test efforts in conjunction with LPS System Integration and Test Manager
- Oversees and monitors software development and test
- Provides technical leadership in software development methodology
- Establishes software policies, standards, and plans
- Identifies applicable software reuse from external sources (such as EDC)
- Conducts walk-through and audits for conformance to software management plans
- Lead efforts to identify, select and procure COTS software packages
- Develops and maintains software interface requirements
- Develops long-term software management and maintenance philosophy
- Member of PCMB
- Defines applicable software-related prototyping efforts

6.6 Software Engineer

The responsibilities of the LPS Software Engineer are as follows:

- Responsible to Software Manager (SM) for LPS software functions as assigned
- Technical lead of LPS software functions as assigned by SM
- Insures consistency and software reuse of the design and implementation within the LPS
- Member PCMB regarding software related changes to controlled baselines
- Provides inputs to LPS SM for evaluation of SEAS contractor on appropriate software functions as required
- Responsible for the development of the Interface Definition Document (IDD) beginning with the software analysis phase

- Works closely with the SE in the development of the IDD and the development of the Data Format Control Documentation developed by the SE
- Other duties as assigned by SM

6.7 In-house Software Development Manager

The responsibilities of the LPS In-house S/W Manager are as follows:

- Heads in-house software development team implement functionality as specified by the Software Manager
- Member PCMB regarding software related changes to controlled baselines
- Other duties as assigned by Software Manager

6.8 Quality Assurance distributed among PM,SEM,SM,HM

All of the above have the following additional responsibilities:

- Develops and maintains QA planning
- Implements and manages the quality assurance program
- Monitors and ensures conformance to standards
- Performs audits as required
- Defines, collects, and assesses quality and productivity data
- Defines and tracks management indicators

Section 7 External Coordination

The LPS Project will need to coordinate activities with many external entities both with in the MO&DSD and outside of NASA. Points of Contact will be established with each group for coordination. The following identifies the external entities:

LGS Management (530)
ECS Management (505)
EDC Operations Management (Dept. of Interior)
NOAA Mission Management Office
Landsat Project (430)
Landsat Ground System Management (Code 502)
Landsat 7 Mission Operations Center (Code 510)
Image Assessment Project (EDC)
Project Science Office (Code 900)

Roles and Responsibilities for the EDC in regards to their LPS effort as outlined in this Project Management Plan (PMP) will be approved and coordinated by the L7 Ground System Manager.

Section 8 Risk Management

The LPS Project Manager will employ appropriate risk assessment and mitigation strategies to insure the successful development of the LPS. Periodic meetings will be conducted with the SEAS contractor to identify risks, probability of occurrence, consequences of occurrence, and developing appropriate risk mitigation strategies. This information will be conveyed as appropriate to management and reported at the LPS reviews.

Section 9 Development Schedule

The following outlines the LPS development schedule:

Concept and Mission Definition Phase 10/1/93-5/30/94

LPS Project Approval Review	6/94
LPS System Requirements Analysis	6/1/94-9/30/94
LPS System Requirements Review	10/94
LPS System Design	10/1/94-11/30/94
LPS Software Requirements Analysis	12/1/94-2/28/95
LPS System Design Review/Software Spec. Review	2/95
LPS Preliminary Design	3/1/95-6/30/95
LPS Detailed Design	7/1/95-10/30/95
LPS Detailed Design Review	10/95
Build 1 Implementation and System Test	11/1/95-5/31/96
Build 2 Implementation and System Test	4/1/96-10/30/96
LPS Release 1	11/96
Build 3 Implementation and System Test	11/1/96-3/30/97
LPS Release 2	4/97
LPS EDC Site Installation	6/97

Release 1 will contain functionality to support the ETM+ Instrument Integration and Test as well as external integration and test activities. The release will consist of two builds. Build 1 will include the typical front end functions: data capture, frame synchronization, PN decoding, Header Reed-Solomon, and BCH Error Detection and Correction. Build 2 will contain functionality to support external interface testing.

Release 2 will be contain the functionality of Release 1 plus those developed in Build 3. Release 2 will be a fully functional release.